

TABLE 4.—Free-air resultant winds (meters per second) based on pilot balloon observations made near 7 a. m. (E. S. T.) during June, 1931—Continued

Altitude (meters) m. s. l.	Los Angeles, Calif. (127 meters)		Medford, Oreg. (410 meters)		Memphis, Tenn. (145 meters)		New Or- leans, La. (25 meters)		Oakland, Calif. (8 meters)		Oklahoma City, Okla. (392 meters)		Omaha, Nebr. (299 meters)		Phoenix, Ariz. (356 meters)		Salt Lake City, Utah (1,294 meters)		Sault Ste. Marie, Mich. (198 meters)		Seattle, Wash. (14 meters)		Washing- ton, D. C. (10 meters)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Surface...	S 84 E	0.6	N 61 W	0.4	S 6 W	1.1	N 6 E	0.3	S 78 W	1.5	S 1 W	2.9	S 32 E	1.2	N 84 E	1.2	S 22 E	2.3	S 78 E	0.8	S 30 E	1.1	N 20 W	1.0
500.....	S 50 E	1.2	N 79 W	0.5	S 71 W	3.2	N 71 W	0.9	N 83 W	3.1	S 13 W	4.6	S 4 W	5.4	N 88 W	0.3	S 10 E	1.8	S 13 W	2.5	N 46 W	3.8	N 46 W	3.8
1,000.....	N 46 W	0.9	N 88 W	1.0	S 85 W	3.8	S 36 E	1.5	N 63 W	5.3	S 33 W	10.8	S 44 W	9.0	S 60 W	1.9	S 56 W	3.4	S 29 W	3.2	N 44 W	4.6	N 44 W	4.6
1,500.....	N 53 W	2.1	S 31 W	1.0	S 74 W	4.0	S 40 E	2.0	N 52 W	4.1	S 40 W	8.5	S 50 W	7.9	S 5 W	1.2	S 74 W	3.0	S 42 W	3.9	N 52 W	5.8	N 52 W	5.8
2,000.....	S 83 W	2.4	S 33 W	1.8	S 79 W	4.6	S 70 E	1.8	N 77 W	4.6	S 41 W	6.5	S 57 W	6.0	S 9 E	3.0	S 4 W	5.8	S 86 W	3.6	S 41 W	4.6	N 56 W	6.6
2,500.....	S 19 W	2.7	S 51 W	4.2	S 59 W	4.7	S 76 E	1.4	N 88 W	4.1	S 54 W	3.8	S 51 W	4.8	S 1 W	4.8	S 30 W	6.5	N 82 W	4.6	S 41 W	3.6	N 54 W	6.9
3,000.....	S 18 W	3.4	S 48 W	6.0	S 47 W	3.7	S 74 E	1.2	S 78 W	4.7	S 54 W	2.8	S 49 W	4.8	S 16 W	6.4	S 48 W	6.5	N 81 W	6.5	S 14 W	4.6	N 50 W	7.3
4,000.....			S 53 W	6.8			N 12 E	1.9			S 55 W	1.2	S 71 W	3.9	S 29 W	7.5	S 45 W	6.9	N 83 W	9.2			N 22 W	9.5
5,000.....							N 86 W	0.9			N 55 W	1.2	N 63 W	5.6	S 18 W	6.6	S 54 W	11.4	N 65 W	15.4				

## WEATHER IN THE UNITED STATES

(Climatological Division, Oliver L. Fassig in Charge)

## THE WEATHER ELEMENTS

By M. C. BENNETT

## GENERAL SUMMARY

June as a whole was abnormally warm in the interior and Northwestern States, while moderate temperatures prevailed in much of the South and Atlantic areas. From Oklahoma, Missouri, and Illinois northward and north-westward the monthly mean temperature averaged from 5° to 9° above the normal, the last week being abnormally warm, with the highest weekly mean temperatures of record for June over large areas. The month was likewise abnormally warm along the south Pacific coast, while generally moderate temperatures for the season prevailed in the north Pacific districts.

The precipitation for the month was rather unevenly distributed, with less than the normal over large areas. The Northeast, much of the Lake region, southern Texas, and the Rio Grande Valley received generous to heavy rainfall for the season, and more than normal was received in much of the Pacific region from central California northward. Elsewhere the precipitation was below normal, especially in portions of the Southeast and Northwest. From 10 to 25 per cent of normal was recorded in northern Alabama and Georgia, eastern Tennessee, and portions of the Carolinas, while in portions of southern Idaho only about one-tenth of the normal was received.

## TEMPERATURE

From the beginning of the month until a little after the middle the temperature presented no features deserving special notice, although in the far Northwest readings were usually several degrees higher than normal, while comparatively cool weather was noted at times in several portions of the eastern half of the country. This tendency to temperatures below normal was most persistent in some parts of the Lake region and in coast districts between the Rio Grande and Chesapeake Bay.

After the 17th marked heat set in over the southern Plains and the central valleys and prevailed during the remainder of the month, generally increasing in intensity and extending until practically all States from the Rocky Mountain foothills to the Appalachians were under its sway. The Atlantic States were somewhat affected by hot weather, yet mainly were not much warmer than normal during these final two weeks of

June, while some districts west of the Continental Divide were experiencing cool weather, particularly the north-westernmost States, during the last week.

The month averaged warmer than normal almost throughout the country, a few areas near Lake Ontario or along the Atlantic or Gulf coast averaging slightly cooler than normal, also much of the far Southwest and part of the State of Washington. From the northern and middle Rocky Mountains eastward to the upper Lakes and the lower Ohio Valley the month averaged at least 3° above normal, and over the northern half of the Plains from 6° to 9° above. The mean temperature was the highest of June record at numerous stations in the northern and middle Plains and the upper Mississippi Valley, while as far to southeastward as Chattanooga, Tenn., it was but slightly below the June record.

The highest marks noted during the last 10 days of June became the record temperatures for all Junes at many stations in the central part of the country.

In general, 100° was reached or passed in every State, save a few small Northeastern States, while some Central Valley States noted marks of 107° to 109°, and South Dakota, 115°. The highest mark reported anywhere in the country was 119° in Arizona. Usually the highest readings occurred during the last three days, but in parts of the upper Ohio Valley and Middle Atlantic States, also the southern Plains, about the 20th, and in the far West on various dates.

The lowest readings of June varied from 48° in several Gulf States to 16° in Oregon, the latter at a high mountain station. Except in the Pacific and northern Rocky Mountain States they usually occurred during the first 10 days of the month.

## PRECIPITATION

In the middle and northern portions of the country between the Rocky Mountains and the Mississippi River the important rains of June occurred at various times in the different States, except the closing week was mainly very dry. To eastward the weeks were about equal in the matter of rains, when the whole area is considered, save the second week which brought little, except in the Lake Superior region and close to the Atlantic coast.

The southeastern and south-central portions of the country had generally scanty rainfall compared with normal, and what occurred fell mainly during the second and third weeks, save that Oklahoma and the Carolina coast had moderate supplies during the first week and

southwestern Texas had decidedly heavy rains during the last week.

In the Pacific Northwest there was practically no rain until the 9th, but afterwards considerable amounts were received, the falls about the 16th being especially liberal and widespread. The San Joaquin Valley in California received considerable rainfall for the time of the year, about the 7th.

Over two-thirds of the States failed to receive their June normal amounts of rainfall. The exceptions were New Jersey and the New England States, Michigan and Wisconsin, and the Pacific States, with Arizona. Massachusetts received more than twice its normal, on the average, Oregon an inch more than normal, and Washington over 2 inches more than normal.

In the States of the western half, which have not been accounted for above, there was usually from a half to four-fifths of the normal June rainfall, but southern Idaho and northern Utah had remarkably little, while the middle and lower Rio Grande Valley had more than normal.

In the lower Mississippi Valley and to eastward decided shortages were noted, especially in northern Georgia and districts adjacent. From Missouri and Iowa eastward the quantities were usually not much below normal, and they generally exceeded the normal in northwestern Indiana and the upper Ohio Valley.

In western Washington 16.39 inches was measured at one station, the largest in the United States proper. In

the South, Runge, Tex., measured 12.58 inches, while the East was led by 11.33 inches at a station in Putnam County, N. Y.

#### SNOWFALL

Scarcely any snowfall was reported from the elevated stations of the Western States, save that a few points in the Sierra Nevada Mountains had measurable falls. It is stated that the northern part of Flathead County, Mont., had an unusually heavy June snowstorm on the 16th and 17th.

#### SUNSHINE AND RELATIVE HUMIDITY

More than the average amount of sunshine was received from the eastern foothills of the Rocky Mountains eastward to the Atlantic, except in portions of the Lake region, the northern Ohio Valley, the far Northeast, and the western Gulf States. More than normal was likewise received in much of California and southeastern Oregon. Elsewhere it was generally near the average.

The relative humidity was above the normal throughout portions of the Pacific States, the southern plateau, and the southern portion of Texas, the upper Lake region, portions of the Ohio Valley and northern Appalachian Mountains and the New England States. However, in all cases the departures were but slightly above normal. Elsewhere the humidity was generally below normal with minus departures rather pronounced in the southern Appalachian region, the southern portions of the Great Plains, and the northern Rocky Mountains.

#### SEVERE LOCAL STORMS, JUNE, 1931

The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A more complete statement will appear in the Annual Report of the Chief of Bureau]

Place	Date	Time	Width of path, yards <sup>1</sup>	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
Olar (near), S. C.	1	5:30 p. m.	4 mi.		\$65,000	Hail	Severe crop damage; path, 7 miles.	Official, U. S. Weather Bureau.
Billings to Ballantine, Mont.	2	4-5 p. m.			25,000	Tornadic wind	Damage chiefly to oil refinery.	Do.
Bridgewater (near), S. Dak.	2	5:30 p. m.	16		500	Small tornado	Cabins destroyed.	Do.
Grand Rapids (near), Mich.	3					Thunderstorms	Power and telephone service interrupted; several buildings damaged.	Do.
Warren, Ill.	3					Wind	Farm buildings and trees damaged.	Do.
Lafayette County, Wis. (southern)	4		4 mi.		4,000	Thundersquall	Several barns damaged or demolished; path, 8 miles long.	Do.
Northboro, Iowa (southwest of)	4				\$75	Tornado and hail	Minor damage to property; poultry killed.	Do.
Waushara County, Wis. (eastern)	4	11 p. m.	3 mi.		3,000	Thundersquall	Buildings damaged.	Do.
Apple River, Ill., and vicinity	5	12:30 a. m.	4 mi.			Severe wind	Property damaged; several thousand dollars.	Do.
Union County, Iowa	5	3-7 a. m.			2,000	Rain and hail	Truck gardens hurt.	Do.
Decatur County, Iowa	5	5 a. m.	3 mi.		4,200	Wind, rain and floods	Buildings and crops damaged; path, 6 miles.	Do.
French (near) to Sedan, N. Mex.	5	12:15-6 p. m.		1	30,000	Tornado and hail	Livestock killed; buildings and orchards wrecked; path, 90 miles long.	Do.
Harper County, Okla. (northern)	5	4 p. m.	2 mi.		160,000	Hail	Damage chiefly to crops; path, 24 miles long.	Do.
Logan and Thomas Counties, Kans.	5	6 p. m.	1,760		30,000	do.	Wheat total loss in places; path, 30 miles long.	Do.
Freedom (near), Okla.	5	6:20 p. m.			15,000	do.	Corps damaged.	Do.
Clark County, Iowa	6	2-7 p. m.			3,000	Wind and hail	Greenhouses and crops damaged; path, 12 miles long.	Do.
Knox and Cedar Counties, Nebr.	6	4 p. m.	Up to 2 mi.		65,000	Tornado	Farm buildings demolished; crops injured 10 per cent in places; path, 18 miles long.	Do.
Indiana County, Pa. (central)	6	4-5 p. m.	1,760		10,000	Hail and wind	Many buildings unroofed; orchards and crops badly damaged.	Do.
Waterville, Kans. (5 miles southwest)	6	4:30 p. m.	300		5,000	Small tornado	Farm buildings wrecked; path, 900 yards long.	Do.
Salina, Kans., and vicinity	6	5 p. m.	6 mi.		10,000	Hail	Much damage to greenhouses and wheat; path, 15 miles long.	Do.
Lincoln, Nebr.	6	5:45 p. m.	2 mi.		80,000	do.	Chief damage to roofs, windows and greenhouses; path, 2 miles long.	Do.
Elk (near), Kansas	6	6 p. m.	300		3,000	Tornado and hail	Farm property damaged; path, 10 miles long.	Do.
Wilson County, Kans.	6	6-7 p. m.			14,000	Hail	Character of damage not reported.	Do.
Olathe, Kans., and vicinity	6	7 p. m.	1,760		60,000	Hail and wind	Chief damage to wheat and oats; trees stripped; path 10 miles long.	Do.
Shattuck, Okla.	6	7 p. m.	3 mi.			do.	Heavy crop loss; path, 6 miles long.	Do.
Eureka (near)	6	7:30 p. m.	17		100	Small tornado	Small farm buildings damaged; path 1,300 yards long.	Do.
Independence, Kans., and vicinity	6	8:30 p. m.	900		1,000	Hail	Greenhouses and fruit damaged; path 1 mile long.	Do.
Greensburg, Pa., and vicinity	6	10 p. m.	880		5,000	Wind	Several farm buildings demolished.	Do.
Pennsylvania (northeastern)	6	P. m.			250,000	Wind, electrical, hail and rain	Extensive damage to buildings and other property.	Do.
Evansville, Ind., and vicinity	6					Thunderstorm and wind	Some delay caused by flooding of streets and sewers; other property damaged.	Do.
Missouri (northwestern)	6		½-4 mi.		75,000	Hail, wind, and rain	Orchards and field crops severely damaged; windows broken.	Do.
Mounds, Ill., and vicinity	6-7		3 mi.		10,850	Hail	Fruits and vegetables injured 25 to 90 per cent; roofs, auto tops, and tents pierced; path 5 miles long.	Do.

<sup>1</sup> "Mi" signifies miles instead of yards.